Sailing Craft with Wheels

Priority Claim

[0001] This application claims priority to, and the benefit of, U.S. Provisional Patent Application Serial No. 60/464,542, filed on April 22, 2003, by Jason H. Eveleth, entitled "Sailing Craft with Wheels," attorney docket no. XYP-001PR.

Field of the Invention

[0002] The present invention is directed generally to the field of water craft. More particularly, the present invention is directed to a sailing craft with wheels.

Background

[0003] Youngsters often start to learn to sail when they are eight to ten years old. Unfortunately many of the boats used to teach them are either difficult to handle, too heavy, too complex or not fun to sail. Traditional sailboats for youngsters generally fall into three categories: sailing dinghies, small single-handed boats (primarily designed for adults), and small catamarans.

[0004] Sailing dinghies, such as the OPTIMIST, available from Vanguard Sailboats of Portsmouth, Rhode Island, are small, relatively light, and not easily tipped over, but they are complex to sail, and also are slow. Also, youngsters outgrow them all too quickly because they are small.

[0005] Single-handed boats, such as the SUNFISH or LASER, also available from Vanguard Sailboats, are faster and fun, but are often too heavy for small children. Further, they can be difficult to land at a beach because their centerboards and rudders must be retracted. They also can tip easily in gusty winds because they have no keels and, in the case of LASERS, have rounded bottoms. This sometimes scares young sailors.

[0006] Small catamarans, such as the HOBIE WAVE, from Hobie Cat of Oceanside, California, are a favorite for young sailors because they are fast, but they can be difficult to turn. They turn more easily if two sails are used, for example a mainsail and a jib, but this requires two sailors and skill. Unlike sailing dinghies, catamarans can be sailed by several children, and

they are easily beached. But even the smallest of the small catamarans can be too heavy for some youngsters. However they do not tip over as easily as the single-handed boats because they do not have rounded bottoms.

Summary of the Invention

[0007] The present invention relates to a sailing craft (i.e., a sailboat), which is simple, light-weight, fun, and fast.

[0008] In general, in one aspect, the invention relates to a sailing craft with wheels. The terms "craft" and "boat" are used interchangeably without distinction to refer to a water vessel. A "sailing craft" or "sailboat" is a water vessel that uses wind for propulsion. In some embodiments, a craft makes use of buoyant wheels for floatation, which has advantages over conventional designs. Some embodiments have features optimized for use by youngsters, such that the craft is light, simple to operate, and stable. Other embodiments include features optimized for use by larger and heavier sailors and/or for higher performance.

[0009] In general, in one aspect, the invention relates to a sailing craft that has features optimized for use by children. The boat is light, weighing about the same amount as a young sailor. The boat is simple to operate, with no centerboard to lift when coming onto shore, and no rudder to submerge when leaving the beach. The boat also does not tip as easily as a single-handed boat such as the SUNFISH. The boat can sail fast in moderate winds, and is stable and can be controlled easily in heavier winds. Further, the deck is a trampoline that can be occupied by one, two or several children, depending on implementation.

[0010] In one embodiment, the boat is a small catamaran-type boat, in the sense that there are floats that support a deck, but the two hulls of a conventional catamaran are replaced by buoyant wheels. For example, in a preferred embodiment, there are four buoyant wheels, one wheel located generally near each corner of the boat deck.

[0011] In a conventional boat, floatation is provided by one or more hulls, steering by a rudder, and tracking (i.e., going straight when the wind is from the side) by a centerboard or keel. In embodiments of the invention, the functions of floatation, steering and tracking can be performed by the wheels, in addition to or instead of one or more of a centerboard, keel, and rudder. Specifically, floatation can be provided by the buoyancy of the wheels, and steering accomplished by turning a wheel or wheels, for example the front two wheels as in an automobile. Tracking can be provided by other wheels while turning and by all wheels while going straight.

[0012] In a preferred embodiment, each wheel is equipped with one or more circular fins around its perimeter which act like a keel or rudder, depending on the wheel's location. For example, if the forward wheels can be turned as just described, fins on the forward two wheels can act as a rudder. If the aft two wheels are held straight, the fins on the aft two wheels can provide tracking like a keel or centerboard. Fins on the wheels thus can help the wheels provide steering and tracking.

[0013] In one embodiment, the fins on the wheels are sufficiently narrow such that they dig into beach sand and prevent the craft from proceeding any substantial distance up the sand when beaching. This is a safety feature that is useful when the craft is controlled by children.

[0014] In general, in another aspect, a sailing craft with four or more wheels serves as a performance sailboat, with such features as increased size and frame strength to carry a crew of two or more and/or larger sailors (e.g., teenagers and adults), additional sails such as a jib and or spinnaker, and in some embodiments, arranging the wheels in particular geometries, such as having four or more wheels in a diamond formation rather than a rectangle.

[0015] In general, in one aspect, the invention relates to a sailing craft having a frame, a sail affixed to the frame, and buoyant wheels. In one embodiment, there are four or more wheels. Two or more buoyant wheels are positioned on one side of the frame, and two or more buoyant wheels are positioned on the opposite side of the frame. The frame can be constructed of aluminum, fiber re-enforced resin or other plastic composite, or any other lightweight material, and a deck is attached, either directly or indirectly to the frame. In one embodiment, the frame has four sides and has a rectangular shape. The frame can also be square, or can have any other shape, for example, triangle, diamond, oval, pentagon, hexagon, trapazoid, cross, and so on. In one embodiment, the frame includes a torsion box structure for strength.

[0016] Each wheel can have one, two, or more fins on some or all of its perimeter. The fins can be affixed to the body of each wheel, or can be integral with (e.g., manufactured as part of) each wheel body. In some embodiments, each wheel is mounted to an axle that is attached to the frame such that each respective wheel can rotate about each respective axle.

[0017] In some embodiments, each wheel is capable of contributing to at least one of floatation, steering, and tracking. For example, in some embodiments, each wheel provides at least two of floatation, steering, and tracking.

[0018] In one embodiment, two forward wheels, one on each side of the frame, each turn to provide steering. In another embodiment, two aft wheels, one on each side of the frame, each

turn to provide steering. In another embodiment, forward and the aft wheels turn, in some combination.

[0019] In one embodiment, the wheels are buoyant, and provide floatation.

[0020] The wheels can include, for example, inflatable or molded rings, or inner tubes. The wheels can be made of any suitable material or combination of materials, including without limitation rubber, plastic, or plastic foam. The wheels can be, for example, spring loaded. The wheels can be in any suitable shape, including without limitation spheres and ellipsoids.

[0021] The wheels can, in some embodiments, provide floatation that would be provided by the hull or hulls of a conventional boat. In one embodiment, the frame is not buoyant, and the only parts of the craft that provide floatation are the wheels. In other embodiments the wheels provide floatation along with other components of the craft.

[0022] In one embodiment, the sailing craft has three or more buoyant wheels attached to one side of the frame, and three or more buoyant wheels attached to the opposite side of the frame. At least one of the wheels on each side of the craft is used for steering, and at least one of the wheels on each side of the craft is used for tracking.

[0023] In another embodiment, the invention relates to a sailing craft including a frame in the form of a cross or diamond. One or more buoyant wheels are positioned on each end of the cross or diamond.

[0024] In general, in one aspect, the invention relates to a sailboat with wheels. In one embodiment, the craft does not have a hull, and wheels provide an interface with the water that typically is provided by one or more hull(s), rudder(s), centerboard(s), and keel(s) of conventional boats. In other embodiments, wheels are used in combination with one or more of hull(s), rudder(s), centerboard(s), and keel(s).

[0025] In some such embodiments, the wheels rotate (e.g., about an axle) in a manner that provides performance benefits on water. In some embodiments, the wheels are buoyant, and help provide or provide floatation. In some embodiments, the wheels help provide or provide one or more of tracking and steering. The performance of the wheels in such embodiments optionally is improved by having one or more fins attached to or integral with one or more of the wheels.

[0026] A sailing craft as described above can be provided in kit form for assembly after it has been shipped to the desired location. This has great benefits in savings of transportation and manufacturing costs as compared to conventional sailing craft.

[0027] In general, in another aspect, the invention relates to a kit for assembling a sailing craft. The kit includes parts (e.g., rods, tubes, bolts) configured to form a frame, mountings configured for a main sail to be affixed to the frame; and wheels suitable for positioning on the frame. If inflatable in whole or in part, the wheels can be shipped in an uninflated state, for further ease of shipping.

[0028] In general, in another aspect, the invention relates to a method for constructing a sailing craft. The method includes providing a frame, affixing a sail to the frame, positioning two buoyant wheels on one side of the frame, and positioning two buoyant wheels on the opposite side of the frame.

[0029] In general, in another aspect, the invention relates to a buoyant wheel for use on a sailing craft. The wheel includes a rim suitable for mounting on an axle such that the wheel rotates about the axle, a buoyant body portion affixed to the rim, and one or more fins about the perimeter of the body suitable for providing at least one of tracking and steering. In one embodiment, the fin or fins are affixed to the body, and in another embodiment, the fin or fins are integral with the body. Various embodiments can have two, three, four, or more fins.

[0030] The foregoing and other objects, features and advantages of the present invention, as well as the invention itself, will be more fully understood from the following description of preferred embodiments, when read together with the accompanying drawings.

Brief Description of the Drawings

[0031] The drawings are exemplary, and are not necessarily to scale, emphasis instead being placed on describing features of the invention:

[0032] Figure 1 is a view of an embodiment of the invention showing the deck and cockpit floor trampolines in place.

[0033] Figure 2 is a view of the embodiment of Figure 1 with the trampoline removed to reveal the craft's frame.

[0034] Figure 3a- Figure 3d show embodiments of wheels.

[0035] Figure 4a – 4f presents a flat view of a frame and steering mechanism in an embodiment of the invention.

[0036] Figure 5a-5b presents a detailed view of the embodiment of Figure 4a-4f showing the section of the frame at the forward end of the cockpit.

[0037] Figure 6 is view of an embodiment of the frame of the invention intended for use by an adult with the deck omitted to show frame details.

[0038] Figure 7 is view of the frame shown in Figure 6 with the deck and cockpit floor in place.

[0039] Figure 8a-8b and 9a-9b show embodiments of wheels.

[0040] Again, the exemplary embodiments discussed with reference to the figures are intended to be demonstrative, and not limiting.

Detailed Description

[0041] Referring to Figure 1, in one embodiment, a four-wheeled sailboat 100 is designed to be a single-handed sailboat that can be controlled by one sailor, and which handles like other conventional single-handled sailboats in many respects.

[0042] Unlike most catamarans, however, in one embodiment, the boat 100 is narrow so that it can heel slightly to leeward somewhat like a mono-hull. Thus, youngsters who learn to sail on this boat 100 will adjust easily to sailing mono-hulls later in their sailing careers. In addition, youngsters enjoy hiking out in a stiff breeze as the boat begins to heel. These activities are facilitated by a narrow boat 100.

The Deck

[0043] A deck 101 is attached to a frame 106, which is partially shown and is described further below. The deck 101 can cover all or a portion of the frame 106, and can be of any size that is suitable for the design of the craft 100.

[0044] For example, in one embodiment, the deck 101 is a trampoline that covers substantially the entire frame, which is approximately about seven feet long and about four feet eight inches wide. The trampoline is in the form of a web, net, or fabric that is attached to the frame. Such a deck 101 can be made, for example, using commercially available Permatron polypropylene fabric, available from Ten Cate Nicolon USA, 365 South Holland Drive, Cornelia GA 30567.

[0045] Any suitable means can be used to affix the deck 101 to the frame. For example, eyelets and tools suitable for installation of a trampoline are commercially available from Hobie, 4925 Oceanside Blvd., Oceanside CA.

[0046] In some embodiments, and unlike most conventional small catamarans, the craft 100 includes a bottom deck 102, which, in combination with a somewhat smaller hole 103 in the top deck 101, forms a small cockpit, with or without sides, such that a sailor's feet can rest on the bottom deck 102. A sailor can also sit on the deck 101 next to the cockpit hole 103, and

when it is necessary to hike out in a heavy breeze, he can brace himself by hooking his feet under the edge of the cockpit hole 103. (It should be understood that a sailor is referred to here as male, although the invention is equally useful for male and female sailors.)

[0047] The bottom deck 102 and top deck 101 can be formed of the same or different material. In one embodiment, the bottom deck 102 is formed from a trampoline as described above for the top deck 101, and measures about 20 inches wide by about 30 inches. Again, material and size can vary depending on implementation, and, depending on the frame design or other design constraints, it may not be possible to form an opening in the deck 101 suitable for use as a cockpit.

[0048] For operation of this embodiment of the craft, when on starboard tack, a sailor will generally hold a mainsheet 104 in his right hand and a tiller extension in his left hand. Pulling the tiller extension 105 towards him, e.g. to starboard in this example, steers the boat to port, as in a mono-hull.

[0049] Referring now to Figure 7, in one embodiment, fiberglass re-enforced resin panels are used instead of trampoline fabric to form the deck 701, on which the skipper sits, and the bottom of the cockpit 702. Since this material is very strong but still light weight, it adds strength to the entire frame assembly. Furthermore, the deck pieces 701 along with the struts underneath the area which holds a sailor form a torsion box 703, which provides additional strength for the frame. As shown in the figure, the torsion box 703 forms a rectangular box structure whose sides are re-enforced with panels or struts. For example, wings on some early biplanes were designed using torsion boxes so that the wings would not twist off. In a sailing craft, the mast and wheels cause torsional stresses, and the frame should be strong enough to withstand those stresses.

The Mast and Sail

[0050] Referring to Figure 2, in which an embodiment is shown with the deck removed, a sail 201 is affixed to a mast 202 and boom 203. These can be any mast and boom suitable for supporting a sail, and made of any suitable material and size, and affixed to the frame in any suitable manner.

[0051] In one embodiment, the mast 202 and sail 201 follow conventional design guidelines. For example, the mast can be about 20 feet tall and made from carbon fiber re-enforced resin, of the sort available from Van Dusen Racing Boats, 277 Baker Ave., Concord MA 01742. (A mast typically comes with a boom.) The sail can be made from Dacron sailcloth

and can be the sort obtained, for example, from Doyle Sailmakers, 89 Front Street, Marblehead MA 01945. Again, these can vary depending upon implementation.

[0052] In one embodiment, the mast is held in place by a conventional step 207, mounted on the frame 209. The step holds the mast in place on the frame 209, and can be equipped with provision for the mast to rotate as the sail is pulled in and out. A forestay 204, a starboard shroud 205 and port shroud 206 hold the mast upright. These can be of the type commercially available, for example from Rig-Rite, Inc., 63 Centerville Road, Warwick RI 02886.

[0053] The sail is also held in place by main sheet 208, which is attached to the frame 209 at a traveler 210 and passes through blocks 211, 212 and 213. This hardware is commercially available, for example, from Harken USA 1251 East Wisconsin Ave, Pewaukee, Wisconsin 53072. A sailor can adjust the position of the sail by pulling or loosening the sheet 208. The position of the sail can further be adjusted by sliding the traveler 210 to starboard or to port.

[0054] As shown, the boat floats on four freely rotating wheels, each rotating about an axle (not shown), including two front wheels 214, and two back wheels 217. As shown, each of the wheels 214, 217 has a fin 215 extending outward from its perimeter. The forward wheels 214 can be turned so that they are straight with respect to the front of the boat, or at an angle with respect to the front of the boat, analogous to the manner in which the wheels on a car can be turned. As the forward wheels 214 turn toward one direction or another, the fins 215 on the forward two wheels 214 act as rudders to provide steering. The fins on the aft two wheels 217, which do not turn, act as keels to provide tracking.

[0055] The boat steering (i.e., the angle that the wheels are turned) can be controlled using any suitable mechanism. In one embodiment, the boat is steered using a tiller 218 and tiller extension 219. The tiller is attached to a tiller post 220, which operates the mechanism which controls the turning of the wheels. Various tiller and tiller extensions are commercially available, and can be obtained, for example, from Layline, 1401 Capital Blvd., Rayleigh NC 27603. The turning mechanism is located below the frame and is described in more detail below.

[0056] Vertical struts 221 are located at various places in the frame to strengthen it. These can be, for example, 1/8 inch thick right angle aluminum extrusions with 1/2 inch legs, available, for example, from Spee-D-Metals, 38356 Willoughby Parkway, Willoughby OH 44094, or for example, Midland Aluminum Corporation, 4635 West 160th St., Cleveland OH 44135.

The Wheels

[0057] Many different types and configurations of wheels are suitable for providing one or more of floatation, steering, and tracking. There may be tradeoffs among these and other functions provided by the wheels. For example, the wheels could be configured to stop in sand, or to travel over sand, and this tradeoff may have an impact on other design parameters.

[0058] Referring to Figure 3a (end view) and Figure 3b (side view), in one embodiment, a wheel includes three principal parts: a body 312, a rim 304 and a fin 305. As shown in the figure, the body 312 can provide an interface between the wheel and the water, and is interposed between the rim 304, which is in the inside of the wheel, and the fin 305 at the outside of the body 312. In general, these parts 304, 305, 312, can be made of any suitable material, form, and size sufficient for operation of the craft. They can be made separately or manufactured together or in some combination.

[0059] The body 312 can be made from a wheel body that is commercially available, such as a standard rubber tire or inner tube, and/or can be custom built, for example, of foam or plastic. The body 312 can be made of, or include, other buoyant material, such as light weight foam, so that the wheel does not sink if punctured. As shown, in one embodiment, the body 312 is in the shape of a donut or torus, but other shapes are also possible.

[0060] In one embodiment, the body 312 is a rubber inner tube, which is buoyant and flexible. Inner tubes are commercially available from a variety of sources, for example, from Hanco Corporation, 3650 Dodd Road, Eagan MN 55123-1305.

[0061] In one embodiment, part number #TUB420 from Hanco is used as the wheel body. When inflated to size, this inner tube has an outer diameter of approximately 40 inches and an inner diameter of approximately 12 inches and a body diameter of approximately 14 inches. These dimensions were selected so that for a young sailor, the wheel will float high enough to provide low resistance to the forward motion of the boat. Other sizes can be used as well, with different performance and cost tradeoffs.

[0062] The hub 302 can be any lightweight wheel, and may be available with or without a manufactured bearing and axle assembly. A bicycle-wheel-type assembly is suitable and widely available, for example, and also includes an axle and a ball bearings assembly on which the rim rotates about the axle. In one such case, the rim 304 is a twelve-inch bicycle rim which is attached to the tube with adhesive. It should be understood that other size rims, either larger or smaller, could also be used. In one embodiment, the rim 304 is, for example, one of a

fourteen, sixteen, eighteen, or twenty-inch rim, or larger. In another embodiment, the rim 304 is, for example an eight or ten inch rim, or smaller.

[0063] A wheel axle can be positioned on the frame in any suitable manner, including without limitation, bolts, brackets, welding, and with fittings. If a bicycle rim assembly is used, there are many different means available, as well as commercially available fittings, to hold the wheel. Other rims could require other attachment.

[0064] In one embodiment that uses a bicycle rim assembly, a hole is provided in the frame for each axle. Each axle is inserted into the hole and tightened with a nut. In another embodiment, the front axles turn for steering, and so those axles are mounted on a vertical rod using a "U" bracket. The bottom of the "U" bracket is bolted to the vertical rod, and the axle is put through holes at the ends of the "U," and then held fast with a bolt or screw. As further described below, the vertical rod is mounted on a pulley wheel that is turned by a cable responsive to the tiller. When the pulley wheel turns, the vertical rod is turned, thereby turning the attached "U" bracket, axle, and wheel.

[0065] As shown, in one embodiment, a fin 305 protrudes from the body 312. This single fin 305 extends from the outside perimeter of the body 312 and is circular or ring-like in shape. The fin 305 can be manufactured as part of the body (e.g., integral with the body) or separate from the body 312, and if it is separate, can be attached later. If manufactured separately, the fin 305 can be attached, for example, by some combination of adhesive, air pressure when the wheel body 312 is inflated, a groove or notch in the body, and/or other means, and can be attached directly to the outside perimeter, or attached to the side of the body 312 or even to the rim 304.

[0066] A fin 305 can have any size that is suitable, which will depend on implementation. In one embodiment, a fin 305 has an inner diameter in the range of 30-50 inches, and an outer diameter in the range of 40-60 inches, and in another embodiment, a fin 305 has an inner diameter in the range of approximately 40-60 inches and an outer diameter of approximately 50-70 inches.

[0067] In one embodiment, the fin 305 has an inner diameter of approximately 40 inches and an outer diameter of approximately 48 inches and is made from a fiber glass re-enforced resin. To aid in holding the fin in place, the wheel body 312 in the form of an inner tube is inflated to slightly more than 40 inches, and is constrained in expansion by the fin. The fin is also held in place by an adhesive, such as used to repair punctures in inner tubes. Fiber glass re-

enforced resin materials can be obtained, for example, from Fibre Glast Development Corporation, 95 Mosier Parkway, Brookville OH 45309.

[0068] The fins on the front and aft wheels in this embodiment have the same inner and outer diameters and are designed so that the submerged area of the two fins on the front wheels is approximately the same as the area of a rudder for a conventional boat of similar size. The area of the submerged fins on the back wheels have approximately the same size as a centerboard on a conventional boat of similar size. Just as the fins 305 can have a variety of shapes and sizes, other embodiments can use larger fins in front or aft, depending on whether turning or tracking is emphasized. The fins in this embodiment are thin so that they displace only a small amount of water, since increased displacement slows down the boat. The fins are also useful to provide a braking action when the boat runs up on a sandy beach. Fins of softer material such as rubber may be substituted, for example for safety, with the tradeoff that if the fins bend, it can be detrimental to the tracking and steering functions. Also, in some embodiments, more than one fin extends from a single wheel. In such case the fins can be the same or a different size.

[0069] If the wheel body 312 is inflatable, and the fins 305 are designed to be held in place by air pressure and/or grooves in the wheel body 312, and light or little adhesive, the fins 305 can be attached by the sailor just prior to entering the water, by putting them in place and inflating the wheel. In such an implementation, and other implementations that allow the fin to be installed just before sailing, or even right at the waterfront, the sailor can have fins of different sizes, and attach the fins with the desired performance characteristics prior to sailing. For example, a longer, deeper fin on the back wheels (if they do not turn) would have a similar effect on boat performance to having a longer, deeper rudder.

[0070] The upper half of Figure 3a, shown above dotted line 311, is a cut-away view of the wheel. The shaded area 310 is the interior of an inner tube.

[0071] The wheel is designed to submerge into the water up to the water line 306. This point is where the profile of inflated portion of the tube is similar to the hull of an ordinary boat. The weight of the boat and the skipper is designed to be or less than equal submerged volume of the four wheels in this situation.

[0072] Descriptions of the factors which determine the performance of conventional high performance sail boats are described in "High Performance Sailing" by Frank Bethwaite, published by International Marine, Camdem, Maine., A Division of The McGraw-Hill Companies. In Chapter 20 on "Hulls," the author states that the speed of a conventional boat is

constrained by displacement drag and skin friction drag, both of which increase with the square of speed under most conditions. Conventional hulls are designed to reduce these effects by planing, i.e., having the hull rise out of the water as speed increases, when strong winds are encountered.

[0073] In the various embodiments of the invention, and in contrast to a conventional hull-based design, drag is reduced because the wheels rotate, which reduces skin friction. Further, as the boat accelerates through the water, the wheels can be designed to plane, e.g., begin to rise out of the water, and the submerged depth, width and length all decrease, which reduces the water's resistance to forward motion. Generally, a flatter wheel periphery will encourage planing, but planing wheels generate more drag at low speeds. Thus, wheels with various shapes can be used for various wind conditions if desired. High-performance implementations can intentionally make good use of wheels designed to plane.

[0074] The performance of the craft can be beneficially influenced by the shape of the wheels and the stability of the shape. In one embodiment, the wheels are made of stiff material such as rigid foam or plastic which will retain shape in the face of stresses induced by high performance sailing. In one embodiment, rotomolded plastic wheels are used. These are commercially available, and can be obtained, for example, from Hardigg Industries, 147 North Main St., South Deerfield, MA 01373-0201.

[0075] Referring to Figures 8a and 8b, at lower speeds, a wheel shape as shown 801 provides such improved performance. Figure 8a shows the end view of the wheel. The wheel is 48" in diameter and 20" wide. Figure 8b shows the wheels from the side. The V shape on the perimeter of the wheel is a broadbased fin which performs the same function as the narrow fin on the wheel shown in Figures 3a and 3b. The center of the wheel contains a bicycle rim and spoke assembly 802 which holds the wheel on an axle. With a total weight of 300 lbs, 100 lbs for the boat and 200 lbs for the skipper, the water line of the boat 803 is approximately at the base of the fin. The wheel can be made from rotomolded plastic or light weight foam with a thin composite shell made from resin and fiberglass. At low speeds, this type of wheel will cut through the water in a manner similar to the hulls of a conventional catamaran.

[0076] Referring to Figure 9, in heavier wind conditions, a wheel shape such as that shown has the advantage of planing at lower velocities than the one in Figure 8. This wheel has two fins 902 around its periphery. As the boat moves forward, the fins enter the water first and form a wave in the middle of the inverted "V" 901 formed by the fins. This wave pushes up against the wheel causing the boat to rise, or plane. The raised wheel displaces less water,

reducing displacement drag which produces a higher forward velocity than otherwise possible. The outside surface 902 of the wheel is vertical thus forming a surface similar to a rudder, which enhances the steering function. Other useful forms of the wheel are also possible, for example including combinations of the above, each having advantages in differing speed and wave conditions.

The Frame

[0077] Referring to Figure 4f, the construction of an embodiment of a frame and steering mechanism are shown as seen from underneath the frame.

[0078] The frame 402 can be constructed in any manner suitable for supporting the sailor, the wheels and the sail, as described above. In general, the frame is designed to be as light as possible, given other constraints. In one embodiment, unlike most other boats, the weight of the body of the boat does not participate in the operation of the vessel. Thus, the frame primarily supports the deck (e.g., the trampoline) on which sailor(s) reside, and provides a means to mount the mast and to operate the sails and steering mechanism.

[0079] The frame provides the same functions, except for floatation, that a hull provides to traditional boats, and in addition supplies the platform on which the wheels are positioned. In traditional boats the hull supports the skipper and/or crew, the mast and rigging, and the steering mechanism. In embodiments of the invention these functions are provided by the frame.

[0080] The construction of the frame follows the traditional design guidelines used in other structures, with the usual constraints on strengths of materials, defection of beams and other dictates of good mechanical design. More specifically, and referring again briefly to Figure 2, the frame must hold the weight of the skipper without excessive defection and must withstand the stresses generated by the wind blowing on the sail 201 and transmitted to the frame through the mast 202, stays 205, shrouds 204, 206 and sheets 208. In addition the frame must support the wheels 214, 217.

[0081] In one embodiment, the frame is designed as two dimensional structure from fore to aft and from starboard to port. This approach provides ample opportunity for support braces 501 such as used in bridge construction, described below.

[0082] Features of the frame are shown in Figures 2, 4 and 6. Referring now to Figure 4, in the embodiment shown, the outer members of the frame 402 form a rectangle, with cross-members 403, 405 adding support.

[0083] The frame 402 can be constructed of aluminum, for example by using aluminum or other metal tubing or rods. Other strong, light-weight materials, for example such as fiber re-enforced resin, or for example other relatively light material, could also be used instead or in combination. One of the significant advantages of a frame that is formed of off-the-shelf parts is it that can be manufactured less expensively than conventional hulls such as those custom-made from fiberglass-epoxy or wood. Fiberglass epoxy and wood are relatively more expensive materials and require effort to form, and need to be manufactured specifically for the purpose. As described, this craft can be cheaply shipped in pieces to its destination in kit form, and then assembled on-site

[0084] In one embodiment, the perimeter of the frame 402 uses an 1/8 inch thick aluminum right angle with legs of one and one and a half inches, which can be obtained from various manufacturers, including Spee-D-Metals, 38356 Willoughby Parkway, Willoughby OH 44094. The cross pieces 403 use the same material.

[0085] The frame also contains "T" extrusions 404 which run fore to aft, and are used to support the forward wheels. These are also 1/8 inch thick and are 1-1/2 wide and 1-1/2 deep. To provide sufficient rigidity, high tensile aluminum alloys can be used or the thicknesses of the extrusions can be increased, to, for example, $^{3}/_{16}$ inch or quarter inch. Stiffening braces may also be used instead of thicker material to constrain weight. Alternatively tubes rather than "T"s can be used. Tubes provide greater torsional strength.

[0086] The extrusions going across the boat 403, 405 and down the boat can be connected in any number of ways. For example, they can be bolted together with standard stainless steel machine screws and nuts with nylon locking inserts or welded together. As mentioned, the size of the frame will vary with implementation. In one embodiment, the outside extrusions form a rectangle seven feet long and four foot eight inches wide the depth of the frame is eight inches, and the axles for the wheels are four inches down from the deck. This arrangement, in most normal conditions, avoid having waves splash on the deck or in the cockpit.

[0087] Figure 4d shows the detailed construction of the cross brace 403 at the front of the cockpit 406 viewed from the top and Figure 4e shows this structure 405 viewed from the back of the boat.

[0088] Referring to Figure 5, enlarged views of the structure 405 are shown in Figures 5a and 5b. The structure is along the lines of what might be used in a bridge, and uses braces 501 which are 1/8 inch thick right angle aluminum extrusions with legs that are 1/2 inches long. The

braces distribute forces on the structure that cause the entire structure to act somewhat like a thick beam so that the structure has the strength a rigidity to hold the weight of the sailor(s) without breaking or bending.

[0089] As described above, it can be useful to design the frame and wheels to be as light weight as possible, so that the boat can be easily handled and moved by a child. Higher-strength construction techniques will make the boat heavier and more expensive, but allow heavier sailors, and even adults, to use the craft.

[0090] Referring to Figure 6, the frame 601 can be made stronger and stiffer, as shown, where the thickness of the lines denote the relative stiffness and strength of the frame parts. The central portion of the frame is rectangular box 603 referred to as a torsion box, which supports other parts. The structure is intended to prevent the frame from twisting under heavy loads from the pressures of gravity, the weight of the sailor(s) and the stress induced by the sail. For example, struts 604, 605 and 606 form a triangle that stabilizes the struts 607 and 608 that hold the back wheels 602. In this embodiment, the wheel strut 607, 608 could use square or round tubing to increase their torsional rigidity in the area where the pressure from the wheels generates this type of stress. The torsion box 603 and other parts can be formed from rods, tubing, angle pieces, "T" shapes or other suitable forms. It is useful, of course, to select materials that are resistant to corrosion from salt water, such as stainless steel, anodized aluminum or composite materials.

Steering

[0091] Any suitable means for turning the wheels at an angle to the boat in response to direction by the crew can be used.

[0092] Referring again to Figure 4f, an embodiment of the steering mechanism is shown from the underside of the frame. As with wheeled land vehicles, the steering is accomplished by causing wheels to pivot direction, or turn, in response to the steering direction indicated by the sailor (e.g., via the tiller). This can be accomplished in any manner suitable for implementing such a change in wheel direction. For example, in figure 4f, the forward wheels 401 are shown turned at a 45 degree angle. They are also shown in cross section to reveal the rims.

[0093] In one embodiment, the steering mechanism includes a pulley wheel 407 which is connected to a rod 408, also shown in Figure 4c. Figure 4c is a side view of the aft portion of the steering mechanism. The rod 408 runs through ball bearings or bronze or brass bushings on the cross brace 403 and the one above it 413. The end of the rod is attached to the tiller 409 which

in turn is affixed to a tiller extension 410. When the wheel 407 is turned clockwise it causes a rope wire cable 411 to move in the direction indicated by the arrows 414.

[0094] The cable 411 is attached to the steering mechanism at the bow of the boat. This mechanism consists of four pulley wheels 412, 415. As with the pulley wheel 407 near the stern of the boat, these pulley wheels 412 are attached to rods, for example, which run through ball bearings or bushings mounted on cross braces as shown in Figure 4c. The forward wheels 401 assemblies are attached to the rods on the outer pulley wheels 415. Figure 4a shows the central two cable wheels as viewed from the front of the boat. When the tiller is pulled to starboard, for example, the cable which connects the pulley wheels 407, 412, 415 causes the rods connected to the center of the pulley wheels 415 to turn, and the turning of the rods causes the forward wheels 401 to turn at an angle to the direction of the boat, in this example counterclockwise, and so the boat turns in a port direction.

<u>Other Embodiments</u>

[0095] Variations, modifications, and other implementations of what is described herein will occur to those of ordinary skill in the art without departing from the spirit and the scope of the invention.

[0096] In other embodiments, for example, the capacity of the boat can be increased, for example, so that it can accommodate a number of crew members, for example, three or more sailors. This could be accomplished by increasing the size of any or all of the frame, mast, wheels and sails. A larger boat could also include a jib and/or a spinnaker. Likewise, the boat can have increased dimensions in some or all areas.

[0097] In another variation, the wheels are arranged at the points of a diamond shape rather than a rectangular one. In this embodiment the invention is a variation of a trimaran and the frame can take the form of a cross or other shape. The forward-most and aft-most wheels take the place of central hull, while the other two wheels act as outriggers. This configuration has the advantage of allowing the crew to move out to the windward outrigger in heavy breezes to keep the boat from tipping over, thereby increasing maximum speed. This craft can then become a very high performance sailing craft particularly if equipped, for example, with a bowsprit, jib and asymmetrical spinnaker.

[0098] In yet another variation of any of the embodiments described, additional wheels are used between the forward and aft wheels on each side. Since they would not be needed to perform the functions of tracking and steering, the fins could be omitted. The advantage of

additional wheels is that each wheel could now be smaller since the buoyancy required of the boat would be divided among more wheels.

[0099] Figures 3c and 3d illustrate an alternative design of the wheel with a round bottom and thin fin. The wheels are not intended to submerge further than the water line 306. Thus the inner part of wheel serves no purpose. If it is eliminated, for example by use of a larger rim 303, the wheel will present less wind resistance and the boat will sail faster.

[0100] In another embodiment the steering mechanism can turn both the forward-most and aft-most wheels, one pair clockwise while the other counterclockwise or vice versa. This enhances the invention's turning ability.

[0101] In another embodiment, the wheels are spring mounted to reduce drag caused by plowing into waves. Other embodiments are also possible based on the use of wheels which provide floatation, steering and tracking.

[0102] In another embodiment, a smaller version of the embodiments described above can be used as a personal craft, like a sailboard. Other design adjustments, such as the wheel shape, can enhance the performance of the invention such that it can be driven on both water and up on land, such as a sandy beach.

[0103] It also should be understood that although the boat described above uses wheels to replace features conventionally provided by one or more hulls, centerboards, keels and rudders, the principles described here can be advantageously employed in combination with hulls, centerboards, keels, and rudders. In some such embodiments, the wheels are buoyant, and help provide floatation. In some embodiments, at least some wheels are not buoyant, but provide one or more of tracking and steering. The performance of the wheels in such embodiments optionally is improved by having one or more fins attached to or integral with one or more of the wheels, as described above. For example, in one such embodiment, one or more hulls have one or more attached wheels. In another embodiment, a frame as described above, also has attached one or more hulls, centerboards, keels, and rudders.

[0104] The invention therefore is to be defined not by the preceding illustrative description or these embodiments, but instead by the spirit and scope of the claims.